Energy transitions and mass publics: manipulating public perception and ideological entrenchment in Japanese nuclear power policy

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Energy Transitions and Mass Publics: Manipulating Public Perception and Ideological Entrenchment in Japanese Nuclear Power Policy

Scott Victor Valentine[1, *] and Benjamin K. Sovacool[2]

[1] RMIT University, School of Global, Urban and Social Studies, GPO Box 2476
Melbourne, Victoria, 300, Australia, email: scott@scottvalentine.net

[2] University of Sussex
Jubilee Building JUB-367, Sussex House, Falmer, Brighton, BN1 9RH, United Kingdom

* = Corresponding author

Abstract: How can leaders successfully craft energy or climate policy to support an initiative that citizens oppose? This paper considers this challenge from a change management perspective applied to public governance. It first draws on change management theory to develop a framework for altering mass public perspectives. The framework consists of four phases: i) problematizing the issue, ii) laying a foundation for change, iii) reshaping perspectives, and iv) entrenching support. Drawing from the insights gleaned from the establishment of Japan's nuclear power program, the paper further argues that in order to succeed in mass perceptual change, policymakers must first clearly understand the contextual environment in which the policy is being formulated. In doing so, policymakers will be better able to customize policy design to appeal to stakeholder perceptions and sentiments. Although the context of this paper is the perceptual modification of public opinion to support nuclear power, the authors suggest that the same framework can be applied to perceptual modification of any policy that the general public might be opposed to. In the energy sector this could apply to fostering a transition to renewable energy as easily as it applies to nurturing nuclear power development. However, the Japanese case puts forth a caveat in this regard, there is evidence that the mindsets of the Japanese policymakers were predisposed to advocacy of nuclear power and once policymakers commit to a technological trajectory, it is hard to engender a change of course. Therefore, the article concludes by speculating on how the perceptions of policymakers might be similarly altered through efforts from the alternative energy sector to foster policy change.

Keywords: nuclear energy; energy policy; change management theory; energy transitions; nudge

List of abbreviations

BWR – Boiled water reactor

CO2 – Carbon dioxide
GHG – Greenhouse Gas
LDP - Liberal Democratic Party
JAEC – Japanese Atomic Energy Commission
JAERI - Japan Atomic Energy Research Institute
JAIF - Japan Atomic Industrial Forum
NATO - Nodality, Authority, Treasure and Organization
NGO – Non-governmental organization
NIMBY – Not in my back yard
R&D – research and development
SWOT - Strengths, Weaknesses, Opportunities and Threats
UN – United Nations
US – United States of America

Word count: 8900

1.0 Introduction

Expeditious energy transition – this is the mantra of many experts working in energy research. The logic underpinning this position stems from varied assumptions that lead to the same conclusion. Some contend that an energy transition is inevitable because investment in renewable energy research and development has reached a stage whereby the commercial allure of these technologies has become undeniably irresistible [1]. Others suggest that the rapid depletion of fossil fuel energy sources portends a corrosive economic picture for conventional energy sources and this factor should catalyze market change [2]. Still others argue that the damages associated with amplified levels of greenhouse gas (GHG) in the atmosphere dictate change regardless of the costs [3]. Across these ideological camps there is one strand of logic that binds – we must transition towards low-carbon forms of energy.

Yet, enabling substantive change is difficult. In this study, we ask: “How do our mental models for change and transition develop?” and “what, if anything, can policymakers do to change mental models?” Without understanding why stakeholders have been supporting a certain technological regime and understanding the mechanisms through which people can be persuaded to alter support, we must simply cede change to natural market forces. This might be acceptable in contexts where time is not of the essence, but in the face of serious social or environmental problems, fostering expedient change necessitates intervention.

This paper seeks to explore and understand the process of managed change with

the intent of explicating a framework for managing energy transitions via mass publics, a term that describes the citizens and voters comprising a particular political system [69]. The study draws from existing literature related to change, learning and change management to construct a framework that describes the essential elements of a change management program from a public policy perspective. It then demonstrates the applied usefulness of this framework by employing it to describe the surprising emergence of Japan's nuclear power program. As Amory Lovin's once remarked, "An earthquake-and-tsunami zone crowded with 127 million people is an un-wise place for 54 reactors" [4]. In this paper, a managed change framework is employed in order to describe how this curious development came about. The Japanese case study helps to validate the relevance of the study's framework for analyzing the contextual environment that impacts change and for developing actionable strategies to expedite the change process at the policy level.

In section two, the theoretical underpinnings of the study's conceptual framework are introduced, along with the study's research design of a qualitative case study. Its merits noting that the emergent framework serves merely as an ontological tool for conducting the critical analysis exercise that defines this paper; therefore, it should not be misconstrued as a prescriptive model for analyzing technology transitions from a policy perspective. Using the framework in this manner is akin to the application of any similar ontological such as the SWOT framework (strengths, weaknesses, opportunities and threats) which was historically used to guide the evaluation of business opportunities. A model such as SWOT is far from comprehensive but it does help analysts evaluate many of the key influences that shape market dynamics. This emergent framework serves the same function, except for policymaking purposes.

The first part of section two examines research pertaining to the phenomenon of change and how it occurs. The focus is on altering paradigms and argues that renewed learning must take place for change to occur. Therefore, after understanding how the impetus for change arises, the section turns to an overview of theories that help describe how we learn. By understanding how and why we learn, conduits through which change could be effected can be identified. The last part of section two explores research pertaining to change management and formulates a four-step process for invoking change. The overall aim of section two is to apply extant theory to guide development of a framework for managed change that can then be used to describe the development of Japan's nuclear power development program through a perceptual modification lens.

Section three describes the rise of nuclear power in Japan through our analytical framework. Why Japan? As the only nation in the world to be victimized by nuclear bombing (and a nation rife with seismic activity), the Japanese nuclear power development program was a government directed program that emerged amidst staunch

public opposition. Yet, by 2010, Japan had the 3rd highest level of installed nuclear power capacity in the world. I The study is motivated by the premise that lessons from Japan can potentially guide policymakers in fostering other types of energy transitions in the face of high public opposition.

Section four summarizes major implications arising from the Japan case study. It strives to place the role of mass perceptual modification within the governance function, noting that this type of activity and the narratives which support it are common practice in many policy areas. The study's analysis acknowledges that not all attempts to alter mass perception lead to beneficial public outcomes. The Japanese nuclear power program illustrates this case. In the end, this program has cost Japanese taxpayers billions in development, operation and resource management costs and exposed the nation to risks that threaten economic, environmental and social well-being. Therefore, the implication section concludes with some thoughts on how the general public can employ our framework to catalyze government change. Section 5 offers three conclusions related to climate and energy policy, energy transitions and the study of energy futures.

2.0 Research and Conceptual Methods: Theories of Change and Qualitative Case Studies

In this section, literature from the disciplines of change management, education studies, psychology, business management, and public policy related to the phenomenon of change, learning and change management are summarized to better understand the precursors to change and to construct a managed change framework which will then be used to analyze Japan's nuclear power development. We also explain and justify our qualitative case study approach.

2.1 Elements of Change

Research from the change management community highlights at least four elements which have relevance for policymakers that are aiming to adopt change management strategies - incentives for change, change alternatives, resistance from entrenched interests and contextual influences on change. Each element merits a short explanation in order to clarify why they frame the potential for change in a given context.

Incentives for change – Substantive change never occurs just for change sake. This is largely because a technological regime arises due to the economic, political, social and environmental needs that it serves [5] and then becomes entrenched as

special interests amass around the given technology [6]. Accordingly, to supplant incumbent technology, an emergent technology needs to deliver greater value in a way that does not invite insurmountable resistance from powerful stakeholders who represent the status quo [7].

Alternative technologies – It follows then that technological change is, therefore, either catalyzed by the emergence of information that renders the incumbent technology less desirable – such as links between particulate matter emissions and health problems in the context of using coal for in-door cooking – or establishes a market opportunity that investors and entrepreneurs deem to be substantive enough to challenge the incumbent technology. In either case, it can be argued that technological transition occurs when it becomes apparent to a critical mass of powerful interests that the incumbent technology is simply inferior to an alternative technology [8]. When this happens, market forces catalyze a shift to the new technology and a new status quo emerges where the victorious technology ascends to a position of market leadership, a phenomenon described by punctuated equilibrium theory [8].

Resistance from entrenched interests – The degree and pace of change is largely moderated by the scale and depth of resistance from special interests who wish to preserve status quo. Research suggests that there are a number of factors that might discourage incumbent technologies from embracing or catalyzing change despite indications that market needs are not being suitably satisfied. Two key economic catalysts merit special mention. One is the level of sunken investment. If it is difficult for a firm that specializes in incumbent technology to divest itself of the technology, there will be elevated resistance to market change [9]. This largely explains why so many public utilities that possess coal-fired generation capacity resist a switch despite government goals to reduce CO2 emissions associated with electricity generation [1]. The second economic factor that discourages change relates to rent seeking behavior. Dominant technologies are typically technologies that have come to enjoy superior economies of scale and can leverage savings to drive investment which further enhances profits [10]. For example, operators of older power plants of any type often enjoy added profits that arise once a power system has been fully depreciated. When depreciation expenses are removed from the profit and loss statement, such power plants deliver far more lucrative profit streams that are hard to turn away from, especially if owned by for-profit privately held firms.

Contextual influences on change – The degree to which existing technological regimes are able to resist challenges from superior technologies depends in part on the

contextual environment in which these technologies operate. These contextual factors can be broadly grouped into four categories – social (including environmental), technological, economic and political [11]. Social factors such as public perception and environmental governance expectations influence the capacity for inefficient regimes to preserve status quo. For example, in many developing nations, poverty is such a social concern that willingness to accept high levels of pollution from existing technologies to boost economic growth is markedly higher than in developed nations [12]. The complications arising from varied technologies competing to unseat an inefficient incumbent technology serves as an example of how conditions within the technological sphere can hinder technological change.

When numerous technologies are viable contenders for fostering change, the competition between these technologies and the special interests that they engender can actually weaken the ability of new technologies to unseat inefficient incumbent technologies [13]. Nations also exhibit stark differences in relation to the economics of different energy technologies. For example, thanks to abundant coal reserves, both Australia and China enjoy a competitive advantage in that resource [14, 15]. Conversely, the quality of wind resources in nations such as Denmark and Germany has given these nations a competitive advantage in wind power development. It is far easier to unseat existing energy technologies with wind power because the economic divide is narrower, particularly in Denmark which has a dearth of coal resources. Finally, political characteristics of a nation can have an impact on whether or not technological transitions occur at an expedited pace. Take the United States as a case in point. The strength of the coal and oil lobbies in the United States along with a high percentage of privately run utilities has severely restricted the uptake of renewable energy technologies [16].

In aggregate, these four elements - incentives for change, change alternatives, resistance from entrenched interests and contextual influences on change - frame the potential pace, scale and scope of technological change. However, establishing *impetus* for change is a necessary but insufficient condition for catalyzing actual change. For change to occur, stakeholders who are powerful enough to drive change must be able to comprehend that change is needed. Therefore, capacity to learn is yet another necessary condition for change.

2.2 Learning and Cognition

In theorizing how people learn, many, if not most, educators ascribe to some version of constructivism. Some contend that our social worlds shape our world views. This has come to be known as social constructivism [17]. The basic premise is that the worldviews of others and the competing discourses that we are exposed to help us to

fashion our own perspectives [18]. There is intuitive logic and a significant body of research which supports social constructivist theory [19-21].

However, people also intuitively know from their personal anecdotes that different people are influenced by different actors within our social world. Some are more influenced by parents, some are influenced by same-age peer groups and some seem to be heavily influenced by media or other less intimate sources. In short, people are influenced by different social actors to different degrees. For the purposes of this paper, this tells us that policymakers who wish to influence stakeholder perspectives need to understand which social conduits most influence the target audience.

Of course, not all learning occurs through contact with others. Sometimes, people learn through personal successes and failures. This process of trial and error learning is commonly referred to as experiential learning [22]. Although there might be a social component to this feedback process, experiential learning proponents argue that learners also draw from their own observations to build mental models. However, one of the flaws of experiential learning stems from contextual dynamics. Learners tend to predict future outcomes by applying lessons from the past, even though the lessons from the past might not be relevant to the current context. Therefore, it is important when analyzing a process of technological change – such as that represented by the Japan nuclear power case – that we look for evidence of experiential learning and consider the impact that past experiences have had on the worldviews of the target audience.

The third and final element of learning that is relevant to evaluating propensity for change relates to the epistemic processes through which people leverage social and experiential inputs to construct worldviews. There is a great deal of evidence that people process information in different ways [23, 24] and this implies that some people might be more susceptible to new information that catalyze reflection over existing worldviews [25]. In lay language, some people are more open minded than others. This is important because in adherence to socio-cultural theory, it is entirely possible that some cultures are more susceptible to the social forces which can entrench beliefs, in spite of evidence that contradicts existing worldviews [26]. This aspect of openness to learning is particularly relevant for this study because Japanese culture is based on rigid hierarchies, social rules and harmony [27]. It is a culture that discourages conflict – thus the oft cited expression, “the nail that sticks up gets hammered down”.

As will become apparent in the analysis of Japan’s nuclear power program, these elements - social constructivism theory, experiential learning theory and cultural rigidity to change - played influential roles in helping to guide understanding of how the program became entrenched in a nation of citizens who are extremely averse to nuclear technology.

2.3 Change Management Theory

Even if conditions for change are positive and stakeholders understand the rationale for invoking change, change can still be slow in coming due to stakeholder resistance and/or apathy. It is for this reason that policymakers who seek to expedite change need to consider strategies to mobilize action. Indeed, public awareness campaigns have been viewed as being both necessary and impactful across a spectrum of policy challenges such as fostering littering prevention [28], reducing instances of drunk driving and sexual assault [29], fostering improved health [30], promoting awareness of racial discrimination [31] and conserving water resources [32].

In order to effectively foster change, research suggests that there are four stages that must be strategically managed. The process, which is not necessarily linear, involves: i) problematizing the issue, ii) creating a foundation for supporting change, iii) reshaping perceptions, and iv) entrenching support.

1. Problematizing the issue. The term "problematizing the issue" reminds policymakers that stakeholders will only support change if they are aware that the status quo is a problem. In addition to engendering political support, problematizing an issue is needed to muster the enthusiasm necessary to encourage stakeholders to accept the short-term pain of transitioning from one technology to another in return for more positive long-term gain. This is because in energy transitions, early adopters stakeholders typically must bear higher up-front costs while the new technology expands to a point where economies of scale can be realized [33]. On the supply side, transitions typically require costly investments in new technology and related infrastructure and similarly costly write-downs of existing technologies. As anyone who has ever adopted a new exercise regime can attest, the inception of change is arduous, even if the long run benefits outweigh short run costs. Change requires short-term sacrifice which will rarely be made in the absence of an impetus to change.

2. Create a foundation for supporting change. The will to change can dissipate in the absence of signals that the issue which has been problematized is being resolved through the implementation of the policy solution [34]. It is for this reason that governments that want to invoke change must lay the foundation for supporting change [35], perhaps even before the desired solution is offered to stakeholders.

3. Reshape perceptions. Once the foundation is in place for supporting the adoption of the desired solution to the problematized issue, stakeholders must be introduced to the solution and given the information necessary to register the proposed solution as being the most effective way to solve the problematized issue. This is seen as an integral part of creating readiness to change [36] and suggests that a foundation for supporting change and reshaping perceptions must be put in place prior to initiating

a campaign to disseminate the preferred solution. Failing to lay the foundation puts the policy regime at risk of having its agenda usurped by other competing alternative solutions and ideological opposition.

4. Entrench support. Positive public support for a given change initiative can be undermined by staunch resistance from special interests and advocacy coalitions [37]. This phenomenon is commonly on display in the wind and nuclear power sectors when NIMBY opposition delays and curtails projects [38, 39]. In order to ward off counter-challenges from supporters of the status quo, policymakers must ensure that support for a transition is entrenched by connecting the well-being of powerful stakeholders to the continued prosperity of the transition. As stakeholder support for a given technology amasses, the capacity for opponents to derail progress lessens. As testament to this, recent interviews of wind power developers by one of the authors has revealed a remarkable amount of apathy toward the threat of wind power protest in established nations such as Germany and Denmark. As one interview subject explained, “we don’t worry about such opposition anymore because mechanisms are now in place to effectively deal with such obstacles.”

To conclude this section, research suggests that the management of effective technological transitions requires a two-stage process that involves: i) establishing an understanding of the contextual environment and ii) adopting a change management strategy that specifically targets contextual barriers to change through a process of problematizing the issue, laying a foundation for change, reshaping perspectives and entrenching support. These elements are summarized in Table 1.

Table 1: A Framework for Managed Change

Phase I: Understanding the Contextual Environment

1. The perceived need for change
2. The availability of alternatives
3. Stakeholder perceptions and sentiments
4. The socio-cultural mindset

Phase II: Invoking a Change Management Strategy

1. Problematize the issue
2. Laying a foundation for changes
3. Reshaping perspectives
4. Entrenching support

Source: Authors

2.4 Qualitative case study design

In the next section this framework is applied to describe the rise of nuclear power in Japan as a qualitative case study. George and Bennet [70] define a case study as a "detailed examination of an aspect of a historical episode to develop or test historical explanations that may be generalizable to other events," while Yin [71] defines it as "an investigation of a contemporary phenomenon within its real-life context when the boundaries between phenomenon and context are not clearly evident." Rather than using statistical analysis of data from a large sample, case study methods often involve detailed, longitudinal assessments of single or multiple cases - which may be individuals, groups, organizations, policies or even countries.

Within case study methodology, the study's exploration of Japan could be framed as an "inductive" and "extreme" case study [72]. It is "inductive" as the study builds its case using a mix of historical evidence meant to show examples affirming the conceptual framework. It is "extreme" in that the Japanese situation is unusual or unique in that it illustrates a rare but important socio-cultural dialectic, that of a nation being attacked with atomic weapons that then pursues atomic-based nuclear power. A strength to this approach is its depth, and its qualitative nature. A weakness is that the study only includes evidence affirming the descriptive viability of the framework within a given context. Consequently, the inductive nature of this case study renders it as a work which falls into the realm of grounded theory [74], which can be defined as the formal categorization of observed influential variables and relationships conducted with the aim to produce testable theory that can be validated through future empirical studies and in different contexts.

3.0 Results: Managing public perceptions for an energy transition

The traditional story of Japan's relationship with nuclear power is straightforward albeit still remarkable. In 1950, 83% of its primary energy supply was provided by coal. A rapid decline in global oil prices combined with diminished domestic coal supplies forced Japanese leaders to rebuke the wishes of Japan's coal lobby and transition to oil. By 1957, coal's contribution to total primary energy had fallen to 65% and oil's contribution had climbed to 26%. By 1973, reliance on oil would rise to 73%, with almost all being imported [43].

However, while these two fossil fuels battled it out over this time period, nuclear power rose considerably. As Figure 1 illustrates, it grew from negligible amounts of national supply in the 1960s to surpass 20% in the mid-1980s and peak at more than 30% in the late 1990s (a trend we examine specifically in section 3.4.1). In exploring the deeper dynamics to this rise of nuclear power, this section of the paper organizes

our discussion thematically, rather than chronologically, focusing on eight core factors.

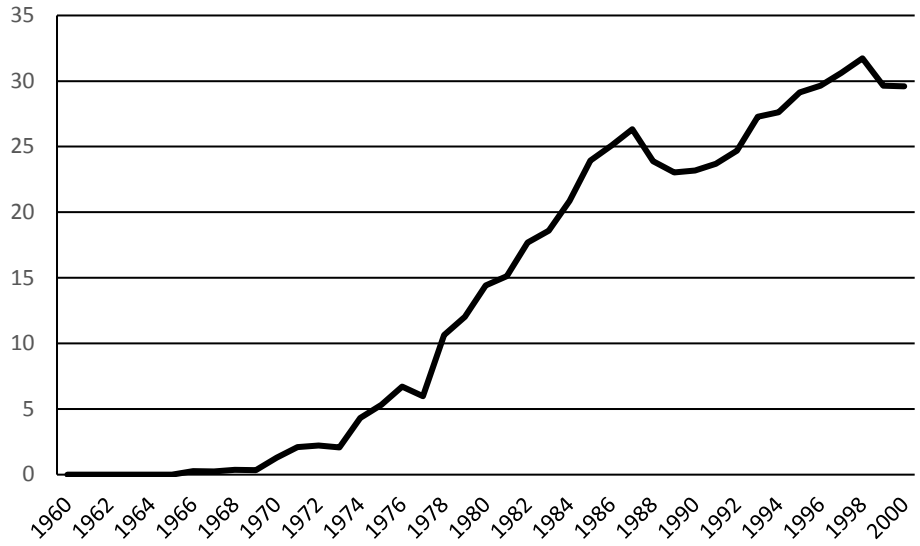

Figure 1: Electricity production from nuclear sources in Japan (% of total), 1960-2000 [75]

3.1 Perceived need for change

As with all energy transition stories, Japan's nuclear power program began as a response to a perceived need for change. In Japan's case, this was precipitated by two key factors – the need to expand energy systems on a large scale to meet burgeoning energy demand and the need to do so in a manner that did not leave the nation as precariously dependent on foreign energy supplies, as had been the case in the past [40].

Post-1945, Japanese economic infrastructure, which had been obliterated in the Pacific War, was in need of a universal rebuild [41]. Many of Japan's largest cities were razed during the war. To many, Japan's military successes during the war were largely attributed to the nation's considerable prowess in large scale industrial production. Some of its companies – Sumitomo, Mitsui, Mitsubishi, and Yasuda – possessed world class industrial competencies and were supported by a web (*zaibatsu*) of highly skilled, specialized small and medium sized enterprises [42]. Post-1945, these competencies still remained, however, firms lacked the capital, the access to energy supplies and the manpower (due to high casualties of war) to rebuild.

The Japanese government, with the help of US financial aid, adopted a proactive program of support for big industry by working with industry groups such as the *Keidanren* to target specific strategic industries for financial support - Industries which

benefitted from support included construction, steel, machinery and, later on, electronics. The one thing that these industries all had in common was that they were industries that could leverage technology to achieve high levels of productivity. This, of course, required energy in vast volumes and for a nation that had consumed virtually all domestically available energy resources in order to support the war effort, policymakers were left with the challenge of determining which type of energy to adopt to support the nation's economic renaissance.

The precarious nature of dependence was not lost on Japanese leaders who did not need a long institutional memory to be reminded of the ills associated with energy resource dependence. During the Pacific War, America and its allies had effectively defanged Japan's military by cutting off access to Indonesia's oil supplies [44]. With domestic coal depleted and oil supplies curtailed by US blockades, the Japanese military was presented with the dilemma of having to leave its fighter planes on the ground and submarines in their berths. This led to the strategic decision to utilize airplanes and submarines as bombs, giving rise to the inception of the kamikaze strategy [44]. In short, Japan had seen its military efforts derailed by the loss of energy supplies and its leaders now again encountered a precarious dependence on an energy supply over which they had no control.

3.2 The search for alternatives

In post-war Japan, the search for alternatives to attenuate dependence on imported oil was problematic because the range of domestic alternatives was so limited. Although coal was an option, it was more expensive than oil. Moreover, coal-fired electricity plants are not well suited to fluctuating electricity demand loads and so coal alone was unable to provide the power flexibility that Japan's factories needed. Moreover, coal is heavier and possesses lower energy content than oil and, consequently, it was less preferred in industries such as steel production and a more expensive commodity to import. The capacity to expand hydropower was limited. What could be dammed, had been dammed. During the energy shortages of the war, the nation had accumulated extensive experience in biofuel production using agricultural crops and crop residue [44]; however, biofuel supplies were clearly insufficient for supporting a nation-wide renaissance of heavy industry.

Amidst this backdrop, nuclear power emerged as an option in 1953, thanks in large part to a speech given by US President Dwight D. Eisenhauer on December 8 delivered to the UN general assembly. During this "Atoms for Peace" speech, Eisenhower explained, "*The United States knows that peaceful power from atomic energy is no dream of the future. The capability, already proved, is here today…. The United States would be more than willing - it would be proud to take up with others þrincipally*

involved," the development of plans whereby such peaceful use of atomic energy would be expedited" [45].

To Japanese leaders this offer held significant appeal. Japanese nuclear research had a track record that extended back over 30 years when Japanese physicist, Yoshio Nishina travelled to Europe in 1921 to mentor under nuclear pioneers such as Niels Bohr. When Nishina returned to Japan in 1928, he set up a nuclear research laboratory that employed over 100 researchers by 1941 [39]. From 1941 onward, Nishina's team was tapped to support research into military applications of nuclear research. In support of this, Nishina began work on the construction of a 60-inch cyclotron to create nuclear fuel but due to resource constraints, the end product wound up to be of inferior quality and eventually only managed to produce 170 grams of uranium hexafluoride – a small percentage of what would be needed for a bomb. When the war ended, United States forces dismantled Nishina's nuclear research program and ordered the destruction of his cyclotron.

With a cadre of experienced nuclear physicists, Eisenhauer's nuclear olive branch seemed tailor made to help Japan address its burgeoning energy needs. In the words of Roger Kingdon, this was the opening of a policy window - a situation where the solution, the ingrained competencies to deliver the solution and the political will were all aligned [46]. This was a power source that scientists at the time declared would eventually be "too cheap to meter" [47]. For the Japanese government, it was a "quasi-domestic" technology that also ran on very small amounts of imported resources [47]. Therefore, in terms of both cost and supply chain security it was irresistible.

3.3 Strategic repositioning and stabilizing regulatory support

Aside from widespread public opposition to nuclear technology, which will be discussed in detail later, resistance amongst Japan's energy power brokers was negligible. Industry, of course, coveted the idea of investing in an energy technology that would become "too cheap to meter". Japan's nine utilities, which were privatized in 1951, were also attracted to the notion of having control of an energy technology that exhibited a cost profile which was not so heavily influenced by fuel costs. Leaders within the Liberal Democratic Party (LDP) saw nuclear technology as a way to reduce import dependence and invest in a solution that fit in with the emergent technocratic spirit underpinning Japan's economic renaissance [48]. Japanese authorities were so keen to pursue the American offer to support nuclear power development that they immediately began to lay the groundwork for accepting the US offer.

The only significant hurdle would be in overcoming extreme public apathy. Given that Japan was and still is the only nation to experience the horrors associated with having a nuclear bomb dropped on its urban centers, it is understandable that during the

1950s, there was a significant amount of resistance to any technology with “nuclear” in the title. This antipathy was exacerbated by events such as the March 1, 1954 incident involving the fishing boat, the Lucky Dragon 5. The crew of this boat had unwittingly strayed into an area of the Marshall Islands were the U.S. was undertaking the Castle Bravo Hydrogen Bomb tests. The entire crew and their fish catch were irradiated in the process. However, it was not until the crew returned to harbor in Yaizu and had sold off its catch that the severity of the exposure became known, with the crew falling ill with acute radiation poisoning [49]. By this time, the fish catch had been distributed to shops around Japan, setting off a nationwide panic over irradiated fish. The event culminated in a petition to end nuclear bomb testing that was eventually signed by 34 million Japanese [50].

It is interesting to note though that even prior to passing the Atomic Energy Basic Law of December 19, 1955 which, as will be described shortly, established the structures and legislation necessary to move forward with a nuclear power program, the government was already laying a foundation behind the scenes to support this highly contentious initiative. In 1954, even prior to establishing the legal framework for guiding nuclear power development, the government had earmarked 230 million yen (approximately US$700,000) for nuclear energy research [50]. This seeded the development of an experimental reactor.

In June 1955, the government without fanfare signed a letter of intent to collaborate with US scientists to advance “the peaceful use of nuclear energy” [48]. Five months later in November, a public ceremony was held at a Shinto shrine in Japan to welcome the atom back to Japan [39]. One of the attendees was a newly elected member of the Lower House – Matsutaro Shoriki [54].

Matsutaro Shoriki was a colorful character. He started work life as a policeman, working his way up to a senior position in the Tokyo metropolitan police force before being dismissed amidst a policy scandal in 1923. In 1924, Shoriki used borrowed funds to purchase a struggling newspaper known as the Yomiuri, a newspaper that he would build into the top selling newspaper in Japan. Leveraging the success of his newspaper, Shoriki expanded his empire by investing in newspapers throughout Japan before founding the Japan Baseball League which he supported through the purchase and rebranding of a Tokyo team, which came to be known as the Yomiuri Giants – a team that to this day is the most valuable sports franchise in the nation [39, 54].

Given his background, it might have surprised the average Japanese of the day to note that the month after passing the Basic Atomic Energy Law in December 19, 1955, the LDP announced the appointment of Shoriki as Chair of the Japanese Atomic Energy Commission (JAEC). In May of the same year, he would also be appointed head of the Science and Technology Agency. Although the appointments might be curious in light

of Shoriki's lack of experience in nuclear power; the appointment makes perfect sense given the challenge that he faced. The government wanted to initiate a nuclear power development campaign but it faced stiff public opposition. The need was not for technical expertise at the helm of the JAEC; they needed a promoter and Shoriki fit the bill [54].

During the same year, the government established the Nuclear Safety Commission, the Japan Atomic Energy Research Institute (JAERI) and the Atomic Fuel Corporation. The Japan Atomic Industrial Forum (JAIF) - an industry special-interest NGO – was also conceived the same year.

By the end of 1956, plans were in place for the purchase of Japan`s first commercial nuclear reactor, a British Magnox reactor and the LDP was also negotiating with US suppliers for 20 more reactors [54]. Moreover, the experimental reactor that had been under development since 1954 was nearing completion (completed in 1957). In short, the government was ready for business but the constituency of voters was not – opposition to nuclear power remained a sticking point in progressing forward.

3.4 Proselytizing success and social cohesion

The success of nuclear power did not depend on industry or government alone. Instead, the Japanese case illustrates compelling cultural, discursive, and social elements as well. We break these inductively into three components: socio-cultural mindsets, national discourse, and mass public perspectives.

3.4.1 Embedding a socio-cultural mindset

Public opposition to nuclear power which stood at 70% opposed in a 1957 poll [48] was so entrenched that nuclear power might have never taken off had it not been for a number of other socio-cultural forces that provided the foundation for campaigns to manipulate public opinion. In order to understand the sentiments impacting public opinion, one needs to go back to pre-Meiji (pre-1868) times.

The Meiji Restoration was a consolidation of political power under the auspices of the Meiji Emperor and as such it is significant in that it officially ended nearly 700 years of feudal rule by military dictators known as shogun. However, in the context of Japan's nuclear power development, it is more important to understand why this event occurred.

From about the 1630s, the ruling Tokugawa *shogunate* began to enact a series of policies to prevent a foreign presence in Japan. This period known as Sakoku lasted for over 200 years, during which time, foreign trade in the country was channeled through a man-made island off the coast of Nagasaki known as Dejima. This policy began to

unravel in 1853 when a flotilla of four blackened US warships under the Command of Matthew Perry sailed into Uraga harbor (part of Yokosuka in the present day) and demanded that Japan open up to foreign trade or face military intervention. The firepower put on display from these "black ships" brought Japanese leadership to a realization that technologically, Japan had fallen far behind. It gave rise to fears of a take-over by foreign invaders and left the ruling *shogunate* shaken. Clearly the nation needed to band together to prevent foreign invasion but it was hard to do when each region was ruled by different dictators. The nation needed a strategy to unite these disparate clans [42]

The solution was found in Japanese myth. It was an entrenched belief in Japanese myth that emperors of Japan came from a lineage that led back to Amaterasu, the goddess of the sun – thus the name for the nation, *Nippon* (literally translated as "foundation of the sun"). Japanese leaders decided that the best strategy for uniting the nation was to use the emperor as a figurehead to unite the nation and then create a political system consisting of prefectural governors who would be responsible for ruling regional affairs while at the same time pledging loyalty to a central figurehead – the Meiji Emperor. This consolidation of power took 15 years from the arrival of the black ships to fully realize but by 1868, the Meiji Restoration was sufficiently entrenched to allow the emperor to issue a declaration to that effect [39, 42, 48].

In order to unify the nation, a number of campaigns were undertaken to shape public perspective. Textbooks were re-written where the links between Amaterasu and the imperial family featured prominently. Japanese youth were taught that being Japanese was a unique honor and that Japanese were indeed very different from other races. This propaganda continued well into the Meiji era and many Japanese historians would concede that these stories and myths laid part of the foundation for military invasion of Asia [42, 48]. Indeed, even Japanese military invasions were not reported in the nation as invasions but were instead deemed to be police actions designed to bring order and Japanese culture to societies of inferior races.

The story behind the Meiji Restoration is important because it established an entrenched worldview amongst Japanese that was still very prevalent post-1945. Japan had on two occasions (the arrival of Perry's black ships and the atomic bombings of Hiroshima and Nagasaki) fallen victim to superior foreign technology. As was the case in fortifying national security after the arrival of the black ships in 1853, the path to enhanced national security post-1945 would need to come through heightened personal sacrifice on the part of all Japanese and a staunch commitment to advancing technological proficiency. It is this mindset that policymakers in Japan would exploit in reversing public opposition to nuclear power [48].

This strategy will be described in sub-sections 3.5.

3.4.2 Reframing national discourse

Today, if one were to ask most energy policy experts in Japan to rationalize Japanese commitment to nuclear power in a seismically active nation, one would hear a familiar refrain that Japan was and still is a nation that lacks domestic energy reserves and so for the sake of economic and national security, a commitment to nuclear power is a necessity. This refrain is evident in government white papers on energy [51] and in strategic documents released by the Federation of Electric Power Companies. It is also a sentiment that dates back at least 70 years to the inception of Japan's commercial nuclear power program. Prime Minister Yasuhiro Nakasone (tenure 1982-1987) described the sentiments at the time, explaining that if Japan stood on the sidelines to witness the largest discovery of the twentieth century, it would "forever be a fourth-rate nation" [52]. In short, despite ready access to oil and other fossil fuel energy supplies in the 1950s, the government mantra was that the nation needed more domestic control over its energy systems [53]. Nuclear power would provide this while also delivering the promise of cheap energy. It was a technology that should be accepted by all for the sake of the nation.

To allay these concerns, the government adopted a program to educate the general populous on the merits of nuclear power. The predominant theme was of a happy and technologically advanced future that was far detached from the on the ground realities of post-war Japan that still lay in ruins from the war. Perhaps the most audacious example of attempts to portray nuclear power as a benevolent technology relates to a 1967 campaign run by the Power Reactor and Nuclear Fuel Development Corporation (a public nuclear research organization) featuring a mascot called *Natriumko* – a cartoon depiction of a drop of liquid metal sodium (Figure 2). *Natriumko* was created to educate the general public on the "safety" of plutonium associated with the energy production process.

Figure 2: Power Reactor and Nuclear Fuel Development Corporation`s Natriumko [76]

3.4.3 Reshaping mass public perspectives

Throughout 1956, with Shoriki at the helm, the government embarked on a nation-wide campaign to reverse public antipathy. In 1956, the government sponsored a road show to herald the benefits of nuclear power in eight cities, culminating in an event held symbolically at a venue near the nuclear bomb blast site in Hiroshima [54]. The event attracted over 100,000 attendees [39]. Newspapers across the country, including many owned by Shoriki, publicized the merits of nuclear power. Moreover, the government dispatched civic officials to school and community centers and disingenuously dressed them in white lab coats so they could help disseminate the wonders of nuclear energy to people at the community level [55]. The euphoria created around the promise of nuclear energy was so prevalent that an atomically modified character named Astro Boy (in English) became one of Japan's beloved manga characters during the 1950s [39].

These efforts were spectacularly successful. Whereas 70% of Japanese considered nuclear technology to be harmful in 1956; by 1958, only 30% felt the same

way [54]. With public apathy attenuated, the rest of the early days of nuclear power were smooth sailing. In October 1963, the nation's first demonstration reactor became operational. In July 1966, the Magnox reactor that was commissioned in 1956 was completed in Tokai-mura in Ibaraki Prefecture (about 100 kms northeast of Tokyo) and came online for the first time. By that stage, plans were already underway for the development of Japan's first indigenously constructed demonstration reactor, a 45 MWe boiled water reactor (BWR) [39, 48]. As the 1970s opened, Japan's nuclear power program had taken hold.

3.5 Ideological entrenchment and path dependence

In the 1970s, Japan's worst energy security concerns were realized. The two oil crises of the 1970s had an enormous adverse impact on a nation that by that time relied on oil for 95% of its energy needs [40]. It became a political imperative for Japan to diversify its energy mix and nuclear, albeit not having ascended to a stage of "too cheap to meter", was still a very attractive substitute given the massive amounts of research and development funding that had already been channeled into the technology.

Despite the gradual dissipation of opposition from the general public, there were still three key hurdles to overcome on the road to expanded nuclear power capacity: i) NIMBY challenges, ii) ensuring support from utilities and iii) attenuating a renaissance in public opposition due to the poor economic profile of nuclear power.

Although public apathy had been assuaged, communities were not keen on hosting nuclear power plants. NIMBY (not in my backyard) resistance was a real challenge as the nation sought new sites for its plants. The government strategy for addressing this played out in two stages. Nuclear site planners would identify smaller villages which were facing economic hardship due to industry relocation and urban migration of youths and then begin a process of wooing the decision makers. It would do so by taking village leaders to other towns where nuclear power plants were sited in order to observe these plants quietly and benignly generating electricity in a remote part of the village [55]. It would supplement this campaign with offers of economic inducement – a community center, a health clinic, a school etc. – in return for hosting such a plant. Through this strategy, Japan's nuclear program expanded from 7 in 1974 to 54 reactors in 2010 [39].

Ensuring support from utilities was a relatively simple matter because nuclear power produced a very reliable base-load stream of energy. Through government agencies that oversaw safety, research and development and subsidized costs, all but generation costs were removed from the cost equation for the private utilities. In short, these utilities found the economic appeal of nuclear power plants to be irresistible.

The challenge of quashing a resurgence of public apathy was resolved primarily

through a reframing exercise. First, the hundreds of billions of US$ funneled into nuclear power came and still comes from various sources including a hidden electricity development tax so consumers are not readily aware of the true cost of R&D. These costs are not incorporated into nuclear power generation estimates. Organizations such as the Federation of Electric Power Companies consistently produce reports claiming that nuclear power is the cheapest form of energy in Japan [56]. Yet, this was (and still is) only true in so far as the behind the scenes costs of managing a nuclear power program (waste management, plant decommissioning and R&D) were not incorporated into the cost of electricity.

Second, public concerns over waste management were attenuated through promises of technological solutions. In the late 1970s, the government announced plans to create a fuel reprocessing facility in Tokai that was intended to reduce waste. It operated from 1981 to 2006 [57]. In 1986, the government commenced construction of a fast breeder reactor – called *Monju* - that would, if successful, eventually reduce waste streams by a significant amount. According to some researchers up to 99% efficiency could be achieved with this technology [58].

Both projects have been extremely costly. Dismantling of the reprocessing facility will apparently take 70 years and cost over US$7 billion [59]. The *Monju* reactor never did achieve its goals and to date has been operable for only approximately 250 days within the past 22 years. In 2016, the Japanese government announced plans to shutter the facility for good, effectively writing off over US$9 billion in sunken investment and committing the government to decommissioning costs that have been estimated at about US$3.2 billion [60].

Fortuitously for proponents of Japan' nuclear power program, the generation phase of the nuclear lifecycle is GHG emissions free. Consequently, Japanese energy planners were able to position the technology as one of the key initiatives for meeting Japan's GHG emission reduction goals. In 2010, prior to the Fukushima disaster, the government had announced plans to expand nuclear power capacity from 30% in 2010 to 40% by 2030 [61]. There was very little opposition on the heels of this announcement. After all, by then, nuclear power had become the central technology within Japan's electricity generation mix.

4.0 Discussion: Implications for energy transitions

What is to be made of Japan's heavily managed relationship with nuclear power that post-Fukushima is now heavily contested? To summarize, Figure 3offers a high level timeline of the interacting phases, also showcasing their mechanisms and some of the external events that shaped their trajectory.

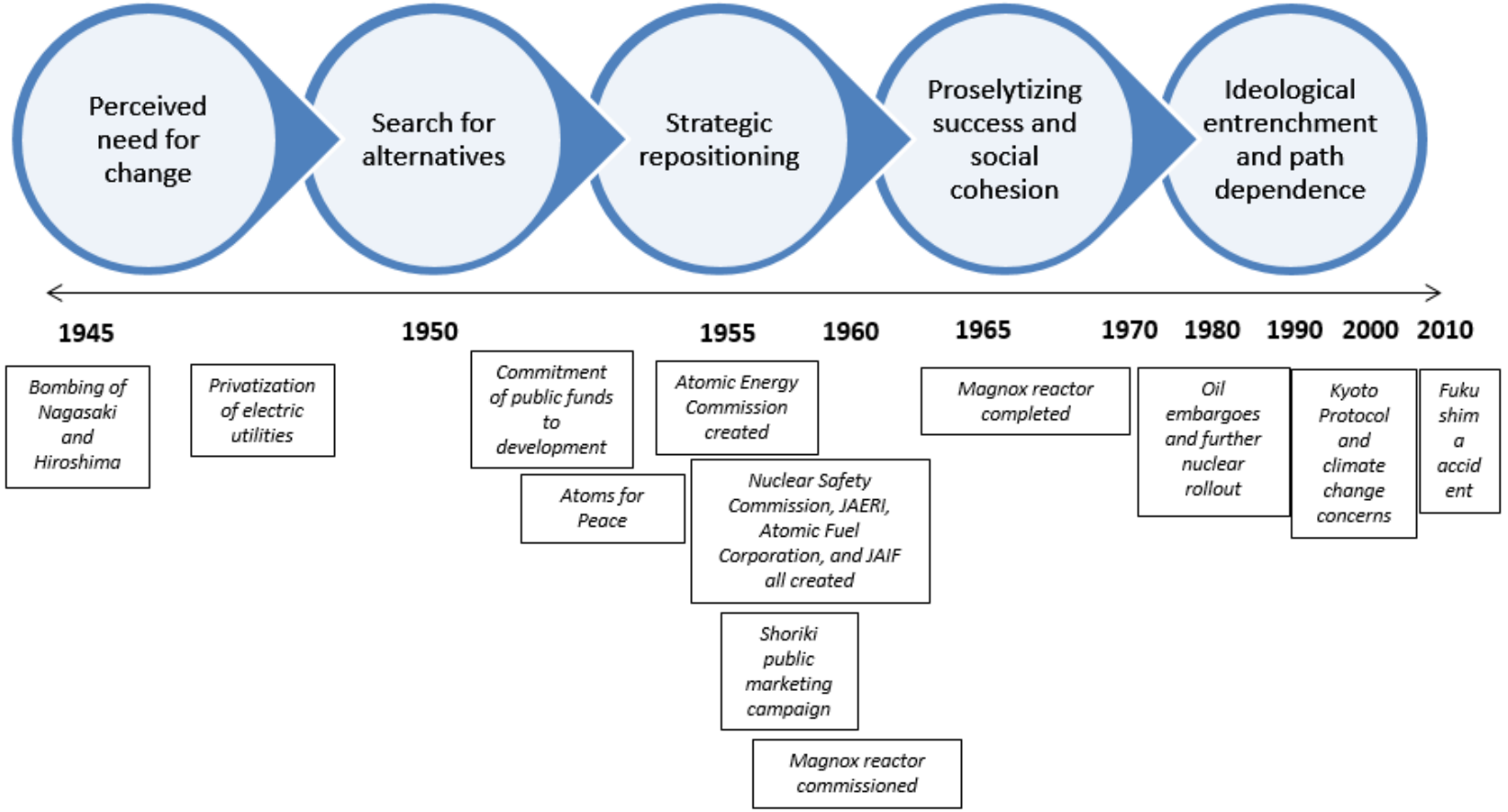

Figure 3: Change, strategy, and ideological entrenchment in Japanese nuclear power development, 1945-2010

Three implications for energy transitions are offered.

4.1 Normalizing mass perceptual modification

At its core, public policy is about behavior modification. Policies are designed in response to problems and those problems typically come about as a result undesirable behavior on the part of a particular sub-set of the population [62]. Therefore, on a daily basis the government is engaging in behavior modification. In itself, the process is not insidious. It is a regular facet of managing a cadre of citizens who possess varied ideologies and self-interests.

Moreover, the government has at its fingertips a number of policy instruments that are designed for enacting change. In the policy literature, these are sometimes referred to as NATO tools – nodality, authority, treasure and organization tools [63]. Nodality tools are all the instruments used for shaping behavior and informing the general public. As was documented in the early days of the Japan nuclear power program, Japanese policymakers are highly proficient at swaying public opinion by using such tools. Authority tools are laws and regulations that could be passed to catalyze change. Again, in the Japanese case, we saw how the government passed a number of laws in 1956 in order to legitimize commitment to a nuclear power development strategy. Treasure tools represent either cash incentives to encourage certain behaviors or cash disincentives (taxes, fines etc) designed to discourage certain behaviors. In the case of Japan's nuclear power program, billions of dollars were sequestered as an electricity development tax to fund nuclear power research. Organization tools represent the institutional choices that governments can make to deliver public services. In the case of nuclear power development, it decided to cede responsibility to a small number of privately held utilities.

Although in hindsight the choices made were arguably misguided, the process of manipulating stakeholder behavior is not a practice to be condemned; it merely reflects the regular role of government.

4.2 The power of narratives

Narratives that are well constructed can frame truth even when there is no single truth, only value judgments. This is a double-edged sword in that the power to invoke change for the worse exists side by side with the power to invoke change for the better.

In the case of Japan's nuclear power program, the narratives and underlying strategic actions which embedded support for nuclear power in Japan presented an overly narrow view of the technology – nuclear power represents Japan's path to enhanced energy security. It presented this narrative in a manner which underplayed or

even marginalized other narratives relating to nuclear safety, construction costs, waste and decommissioning.

This then provides us with an important caveat regarding the deployment of narratives for altering mass perceptions – the salespersons can become the most ardent disciples [64]. This becomes a governance problem when those salespersons happen to be the policymakers who should be responsible for protecting public interests and serving the public will. There is a term to describe when fiduciary public duty responsibility is usurped by favouritism toward members of a particular technological regime – regulatory capture [65].

There might be periods when the interests of the general public and those in support of a given technology are aligned; however, policymakers should always be cognizant that technologies evolve and stakeholder needs and expectations change. Therefore, policymakers should be vigilant to avoid technological lock of the kind that Japanese policymakers have become subservient to.

Promisingly, the same process that got Japanese policymakers into a period of energy insecurity may get them out of it. Problematizing the issue by acknowledging that times have changed and a new technological direction is needed can get the process started. Laying a foundation for change by restructuring the Japanese energy sector to encourage greater competition amongst power generators and to force utilities to accommodate alternative energy inputs will start the market moving in other directions. Finally, reshaping perspectives by focusing on a new array of benefits associated with a shift to alternative technologies should be easy because the majority of the general public in Japan wants change. However, to do so, the government needs to acknowledge that the current energy strategy that endorses continued use of nuclear power is problematic. In other words, the salesmen need to acknowledge that the products they have been peddling for the past 50 years are no longer desirable.

4.3 The duality of discourse

This then leads to a final observation. If policy transition is difficult for governments because of ideological entrenchment, it might very well be the case that such entrenchment can be altered by the citizenry.

The average voter in Japan could largely catalyze policy change by choosing to support candidates that aspire to an energy transition. The problem is, these same voters have been inculcated with the belief that nuclear power, despite its dangers, is still the best choice for the nation. In other words, they have purchased the products that the salesmen were selling, viewed the advertisements that confirmed that they made the right purchase decision and now they too have become disciples. Or at least many were until the protests surrounding the Fukushima disaster encouraged open debate on the

topic of nuclear energy.

As was the case back in 1953, when the nuclear power policy window opened with the Atoms for Peace speech, another policy window has opened to provide alternative energy providers with a chance at driving an energy transition. However, to be successful they need to strategically sway public opinion in much the same way that the government did so between 1956 and 1958. Although they do not enjoy top-level government support and do not possess a champion of the same proficiency as Matsutaro Shoriki, they do have some powerful backing in political circles (eg. Former-PM Naoto Kan, Niigata's governor Ryuichi Yoneyama), enjoy financial might from some of Japan's wealthiest business people (eg. Softbank's Masayoshi Son) and can tap into an increasingly vocal opposition movement. That being said, Japan's ruling party – the Liberal democratic Party – exhibits deeply entrenched support for nuclear power and change will not be easy [66].

5.0 Conclusion

Three conclusions are offered—for climate and energy policy, for energy transitions, and for the study of energy futures.

First, for those interested in energy and climate policy, the story of Japanese nuclear power policy offers a caveat regarding efforts to shape public perceptions – sometimes the policy goal gets lost in the rhetoric surrounding the sales pitch. In Japan, more effort was perhaps put into selling the idea than perfecting the technological promise i.e., non-technical dimensions such as managing social acceptance and cultural legitimacy sired technological acolytes who seemingly forgot that building better reactors, creating better safety regimes and constructing sustainable spent fuel repositories represented the true goals. The role of visions and hopeful narratives become even more forceful when connected to broader ambitious goals about technological futures. When invoking technological narratives, perceptual manipulation efforts run the risk of engendering the belief that the ends justify the means. In developmental states, where policymaking is largely authoritarian in nature, the risk of regulatory capture is high.

The Japanese case also describes a tactical process, depicted in Figure 4, for how to shift a society from a state of complete antagonism to one of complete acceptance: (1) Re-problematize it, connect it to pressing security or economic issues, (2) Build the necessary infrastructure for technical development, investment and policy support, (3) Actively mold public opinion, focus on the positive, indoctrinate and educate, insulate policies from criticism, and (4) Entrench the ideology so that it spans institutions and time periods, leading to obduracy and path dependence, sunken investment, and tightly controlled feedback loops. Essentially, this tactical process in Figure 6 shows how, for

better or for worse, planners could move the public from a state of almost universal antagonism and opposition to public support and ideological entrenchment.

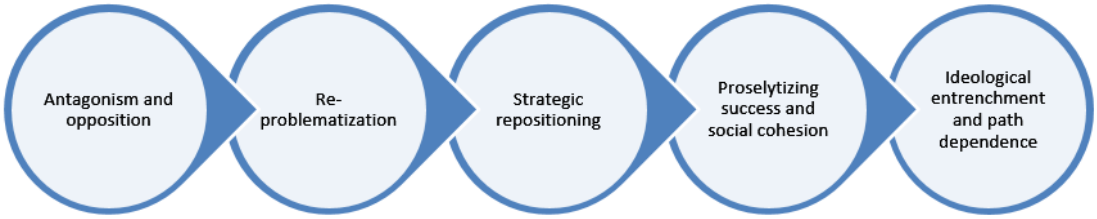

Figure 4: A blueprint for managing mass publics and energy transitions

Second, for those interested in energy transitions, the Japanese case reminds us that the state can drive change—we need not wait desperately for new innovations from the market. However, the work requires a heavy spade. In order for the Japanese nuclear power program to flourish, powerful interests had to align, e.g. privatization (empowerment) of utilities, support from industry, support from government, and these actors then needed to legitimatize the strategy through an extraordinary number of acts, laws, regulations, etc [67, 68]. In the Japanese case, despite having this alignment, it still took many years and substantial amounts of investment to catalyze the nuclear transition. Moreover, there needed to be a window of opportunity created by changes in the exogenous environment - an offer for technological transfer through the Atoms for Peace program, scarcity of oil, pressing energy needs, and the quest for Japan to remake itself through technological innovation.

Third, and lastly, this study should be seen as advocacy for a more critical, reflexive approach on debating energy futures. Researchers and even policymakers need better conceptual forums to identify when campaigns of mass perceptual modification occur and better networks to help educate the general public on the technological trade-offs advocated by powerful interest groups. Through enhanced scrutiny the technological decisions that we make might not always be the right decisions in hindsight but at least the decisions will more adequately reflect the will of the people. Questioning is how people learn and stakeholder expectations become aligned. Energy transitions themselves become more pluralistic and as a result, not only more sustainable, but more legitimate, just, and acceptable [73].

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